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## AGRICULTURAL NOTES

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## SOME PINEAPPLE PROBLEMS.

## ART. 23. - SHIPPING.

By Henry C. Henrickson.

By using the knowledge of pineapple growing that has become available during the past three years the growers in Porto Rico can be reasonably sure of successful production. But there are yet too many slip-shod methods in shipping, the use of which militates against the industry being as profitable as it ought to be. Sizing, for instance, is not uniform and consequently packing is not. Decay is not properly guarded against by all shippers, although present knowledge on that subject is sufficient to eliminate most of the decay when properly applied. The proper temperature for shipping fruit of a certain maturity seems to be imperfectly understood although the question has been discussed before in these Agricultural Notes. In the following brief discussion the more desirable points in shipping practice are summarized.

**SIZE AND WEIGHT OF FRUIT.** - Pineapples are packed in crates that are 12x10-1/2x36 inches, inside measure, with a partition in the middle. The fruits are placed crosswise in the box, one layer with the butts towards one side and the next layer with the butts towards the other side. In that manner a certain number of fruit of a certain diameter will fill the box, and it is that number which constitutes the size in commercial parlance. Aside from the diameter the volume and weight naturally vary with the length of the fruit and to a smaller degree with the size of the crown. The weight also varies with soil and climatic conditions and of course it is less when the fruit reaches the consumer than when it leaves the packinghouse because of loss by respiration and transpiration.

According to weighings at different plantations a packed box of size 16, 18, 24 or 48 may be expected to weigh 71 to 74 lbs. net. A box of the sizes 12, 30 and 36 may weigh 74 to 77 lbs., and the size 24 may average 78 to 80 lbs. These figures may not apply to fruit on all plantations nor at all seasons but they indicate to the consumer what he may expect when he buys pineapples by the box or the piece. The unit weights in the following table are calculated on 71, 74 and 78 lbs. per box for the sizes grouped as above.

| Size. | Diameter. - Inches. | WEIGHT. |         |
|-------|---------------------|---------|---------|
|       |                     | Lbs.    | Ounces. |
| 48    | 3-11/16 to 3-7/8    | 1       | 7       |
| 42    | 3-7/8 to 4-1/8      | 1       | 11      |
| 36    | 4-1/8 to 4-3/8      | 2       | -       |
| 30    | 4-3/8 to 4-3/4      | 2       | 7       |
| 24    | 4-3/4 to 5-1/4      | 3       | 2       |
| 18    | 5-1/4 to 5-5/8      | 3       | 15      |
| 16    | 5-5/8 to 6          | 4       | 7       |
| 12    | 6 to 6-1/4          | 6       | 3       |



The consumer may also wish to know what percent of the fruit is edible. That also varies, but in the sizes 16 to 30 he may expect 35% crown and peel, 15% pulp and 50% juice by squeezing the pulp through muslin by hand.

**PROPER SHIPPING TEMPERATURES.** - The use of refrigeration together with proper cooperation between the growers and the commission men will aid greatly in stabilizing the fruit trade. Those who are yet in doubt about the value of refrigeration for pineapples may learn much by keeping packed boxes at the temperature under which the fruit was shipped and for a length of time corresponding with that required for the shipped fruit to reach the consumer. Such experiments have been conducted from time to time as part of these pineapple investigations and the results may be summarized as follows:

CONDITION OF FRUIT WHEN KEPT AT ABOUT 80° F.

| <u>MATURITY.</u>         | <u>AFTER 1 WEEK.</u>                            | <u>AFTER 2 WEEKS.</u>                       |
|--------------------------|---|---|
| Showing color at butt.   | Fully colored.<br>Too soft for shipping.        | Decaying.                                   |
| Usual shipping maturity. | Starting to color.<br>Firm enough for shipping. | Fully colored.<br>Too soft for shipping.    |
| Very immature.           | No color.<br>Very firm.                         | Fully colored.<br>Firm enough for shipping. |

This shows that at 80° F. a fruit which is nearly plant-ripened cannot safely be shipped to New York even though it may be consumed there within a few days. Also it shows that a fruit at the stage of maturity at which most pineapples are shipped from here will be at its best in about a week from picking but too soft for further handling two weeks from that time.

The very immature lot of fruit was, as a matter of fact, at the stages of maturity which some growers ship and the data shows that it becomes somewhat colored and, therefore, salable in about two weeks after picking. Also it shows that such fruit may be shipped to western distribution centers such as Pittsburgh or Chicago without being refrigerated. But, of course, the eating quality is poor compared with that of the more mature fruit.

CONDITION OF FRUIT WHEN KEPT AT ABOUT 40° F.

| <u>MATURITY.</u>                    | <u>AFTER 5 DAYS.</u> | <u>AFTER 10 DAYS.</u>     | <u>AFTER 15 DAYS.</u>                 |
|-------------------------------------|----------------------|---------------------------|---------------------------------------|
| Lot (1)<br>Showing color at butt.   | No change.           | Slight color development. | Slightly more colored but flesh firm. |
| Lot (2)<br>Usual shipping maturity. | No change            | No change.                | Slight change in color.               |
| Lot (3)<br>Very immature.           | No change.           | No change.                | No change.                            |



## CONDITION OF SAMPLES OF THE ABOVE FRUIT WHEN KEPT AT 82° F.

FIVE DAYS AFTER IT WAS REMOVED FROM THE REFRIGERATOR.

| LOT NO. | 5 DAYS REFRIGERATED.        | 10 DAYS REFRIGERATED.                    | 15 DAYS REFRIGERATED.                       |
|---------|-----------------------------|--|---|
| (1)     | Fully colored but no decay. | Starting to soften.                      | Decayed.                                    |
| (2)     | Fully colored but firm.     | Fully colored. Firm enough for shipment. | Not well colored. Firm enough for shipment. |
| (3)     | Slight color changes.       | Color developing but very firm.          | No color change. Very firm.                 |

The data in the foregoing two tables show that at about 40° F., plant-ripened fruit will remain firm enough for ten to fifteen days to withstand shipping. Fruit of the usual shipping maturity may be kept at 40° F. for fifteen days without changing much, but it is not safe to keep it at such low temperature for much more than ten days for after that time the final maturity changes including coloring may not take place.

What was said about the former lots applies to the very immature fruit as well when kept at 40° F. Color does develop in such fruit after being kept at 50° F. to 55° F. for several weeks, but a prolonged exposure to such low temperature as 40° F. seems to arrest the normal maturity changes.

This indicates that for prolonged storage of yellow-colored fruit a temperature of 40° F. or below is most suitable, whereas green colored fruit should not be kept at such low temperature for much more than ten days/after that time it does not turn yellow. At 55° F. some maturity changes take place and green colored fruit can be kept at that temperature for several weeks. It is not probable, however, that it will pay to cold storage green colored fruit. Cooling is valuable mainly in connection with shipping and especially shipping of fruit that is nearly plant-ripened. Such fruit will always sell at a premium after the dealers learn how to handle it and the consumers get to realize its superior quality.

**DECAY.** - Whenever a fruit is decayed it is usually infected with fungi; therefore, the belief has gained ground that fungi are the cause of all fruit decay. That is a mistake. A pineapple becomes decayed even though it is kept under aseptic conditions. Enzymatic or so-called ripening-changes proceed slow or fast according to temperature and the results of these changes, amounting to decay, become visible sooner or later according to the stage of maturity at which the fruit was picked. That in itself is not a serious problem for even a plant-ripened fruit may be kept at 80° to 90° F. for a week or more without serious deterioration. The more serious problem is how to handle the fruit without bruising it, for bruising causes decay, fungus decay usually but enzymatic decay at any rate, even if fungi are eliminated. Therefore, disinfection of the surface is not an infallible remedy even though it were practicable, which it is not because of the rough exterior of the



fruit. The only remedy for the decay that is caused by bruising is to avoid bruising.

When the tissue is firm and not injured fungi do not enter it, but the stem-scar resulting from picking leaves an unavoidable avenue for the entrance of fungi and, what is not generally recognized, it is the starting point for abnormal enzymatic decay. The most practicable as well as the most efficient preventive against both kinds of decay is sundrying. That is accomplished by the well known method of setting the fruit on the crown and exposing the butt-end to the drying effect of the sun. It is not well to continue the drying too long, especially when the sun is at zenith as that may cause splitting, all that is necessary is exposure until the stem-scar is white and dry. Some fruit requires much longer exposure than other, in fact, a few fruit cannot be thoroughly dried. Those should never be shipped regardless of size and quality for they are liable to become decayed before reaching destination. The sun-cracked fruit are usually shipable; if doubtful the cavity may be filled with melted paraffin after the tissue is thoroughly dry.

The necessity of drying cannot be too thoroughly emphasized for it is one of the most important factors in pineapple shipping. Much has been expected from disinfection but exhaustive tests with many disinfectants have shown the futility of it except at times when the black rot, caused by the fungus *Thielaviopsis*, is troublesome. As a preventive against that the stem-scar may be brushed over immediately after picking with a solution of mercury bichloride, 1 part to 1000 parts water, or an ammoniacal solution of copper carbonate 1 part to 500 parts water may be used. Formalin in a 1/2% solution is also useful but in all cases the solutions should be merely brushed on, not sprayed nor poured on. A large amount of any solution or of pure water poured into the cavity will cause damage for the fruit will absorb it and decay of the heart will follow promptly.

The sun-curing offers no problems when the weather is favorable, but with rainy and cloudy weather many difficulties arise. Some growers have tried to dry the fruit by blowing air over it in the packinghouse but that is not efficient. Others dry the air before it enters the blowers and that is much better although it is not equal to sundrying. One grower has recently adapted a new method and others are following it; it consists of placing the fruit on the ground, butt-end up, under frames 6 to 7 feet high covered on the top with tarpaulins and at the sides with curtains. When the sun shines the tarpaulins are rolled off and when it is cloudy and showery they are replaced. The side curtains are likewise manipulated to keep out the rain and admit the breeze. This method is economical and it protects the fruit from water entering the butt which is of great importance. Drying proceeds, of course, according to the movement of the air and the relative humidity of the atmosphere.

Not some one should attempt to dry the stem-end with a hot flame or a hot iron it may be stated that this has been tried. It can be done without injuring



the fruit, but the stem tissue immediately in touch with the hot object is killed after which it absorbs moisture from the underlaying tissue and becomes mouldy in a short time.

H A N D L I N G . - According to the foregoing discussion the three main points to consider are: (1) thorough drying of the stem scar; (2) avoidance of bruising, and (3) cooling. The drying problem is a local one, it may exist for a very short time only, but it is liable to come at a time when least expected and it will pay to be prepared for it. The bruising likewise is a local problem. Where field conditions are especially difficult it is advisable to carry the field crates some distance by hand rather than to subject the fruit to oxcart-transportation over rough roads. Often it is well to set the fruit in the field crates with the crown down, in order that the latter may act as a buffer. The point to remember is that if the fruit has been well dried decay will not usually enter through the stem-end. Therefore, most of the decay reported by the receiver must be due to bruising and most of that bruising must have taken place previous to shipping for nowadays rough handling on the wharves is supposed to be taboo.

Cooling is entirely a question of personal preference. The growers who prefer to ship immature fruit are not interested in it. Those who wish to supply what the market demands must ship fruit at different stages of maturity and the more mature fruit must be refrigerated at least while it is in transit between Porto Rico and New York.

A discussion of how the fruit should be handled after it reaches New York is perhaps not within the scope of this article. It is hoped that the commission men will familiarize themselves with the different stages of maturity so that they can give intelligent advice to the growers regarding the fruit they can handle to best advantage. Those who make rail-shipments to distant points should be prepared to load the cars properly and refrigerate them when needed. Those who have a demand for fancy fruit, for window display, may advise the growers to dip such fruit in melted paraffin before packing it. This treatment makes the fruit more attractive and much more serviceable for display purpose.

It has been suggested that immature pineapples may be shipped and colored with ethylene gas at destination. It is hoped that this suggestion will not be followed, for as explained in this paper some of the maturity changes, which increase the palatability of the fruit, are arrested by picking. The action of ethylene does not materially increase the palatability and a fruit artificially colored is but a poor substitute for a mature fruit. Artificial coloring is entirely unnecessary for pineapples. A fruit picked say two weeks before it would color if left on the plant will color without artificial means after picking. If it is picked at so immature a stage that it does not color up afterward the fruit should not be sold for consumption for it will serve to curtail the sale of better fruit. The trade in juice for beverage is increasing but it cannot be successfully built up with immature fruit. The watchword for the future should be MATURE FRUIT.

